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BENEFICIATION OF ROCK SALT SAMPLES FROM PUGWASH, N.S.

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MICROMEDIA

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BENEFICIATION OF ROCK SALT SAMPLES FROM PUGWASH, N.S.

by

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ABSTRACT

Two rock salt samples submitted by The Canadian Salt Company Limited, Pugwash, N.S., were sized and selected fractions treated in a Sortex 621M electronic colour sorter to remove the principal impurity, anhydrite, in an effort to upgrade the salt product to road salt specifications, namely -6.7 mm, +0.6 mm (minus 3, plus 30 mesh) in size, and grading 95% NaCl minimum. Following sizing, rejection of the minus 0.6 mm undersize, and colour sorting trials of selected fractions, specification products were successfully produced with each sample, recovery of salt content and grade (% NaCl) being respectively 81.5% and 96.0% for Sample 1, and 85.7% and 95.8% for Sample 2.

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ENRICHISSEMENT D'ÉCHANTILLONS DE SEL GEMME PROVENANT DE PUGWASH, N.-É.

par

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ABSTRACT

Deux échantillons de sel gemme ont été soumis par la Canadian Salt Company Limited de Pugwash en Nouvelle-Écosse. Ceux-ci ont été calibrés et des fractions choisies ont été traitées dans un appareil Sortex 621M servant à séparer les minéraux en fonction de la couleur, afin d'enlever la principale impuré soit l'anhydrite. On a procédé à ce traitement dans le but d'améliorer le produit de sel gemme pour qu'il réponde aux spécifications du sel routier soit les dimensions suivantes: -6,7 mm, +0,6 mm (moins 3, à la maille plus 30) et une teneur d'au moins 95 % NaCl. Suite au calibrage, le rejet des fractions déclassées de moins 0,6 mm et les essais de séparation en fonction de la couleur des fractions choisies ont permis de produire à partir de chaque échantillon des produits répondant aux spécifications. La récupération du sel et sa teneur (% NaCl) était de 81,5 % et 96,0 % pour l'échantillon 1, et de 85,7 % et 95,8 % pour l'échantillon 2 respectivement.

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INTRODUCTION

The Canadian Salt Company Limited operates an underground salt mine at Pugwash, N.S., for the production of a -6.7 mm, +0.6 mm (minus 3, plus 30 mesh) road salt for ice control purposes. In addition to this size specification, road salt should contain a minimum of 95% NaCl (1). The company noted that grade was running at only 92% NaCl with anhydrite, ($CaSO_4$), being the principal impurity. CANMET assistance was requested in identifying a dry processing technique that could be utilized to upgrade the Pugwash product to road salt specification. CANMET agreed to undertake a preliminary investigation to determine technical feasibility with a view to undertaking further studies under the N.S. Mineral Development Agreement should results appear to warrant such additional work.

SAMPLE DESCRIPTION

Two salt samples, each weighing about 100 kg, were received in October, 1985. They were identified as Sample 1, maximum scalping, and Sample 2, nonscalping. Visually, both samples appeared similar, being essentially minus 4 mesh in size and composed of a 50:50 mix of clear, transluscent grains of sodium chloride and light grey to brown grains of lower purity sodium chloride, with minor opaque, off-white to grey grains of mineral impurity.

PRELIMINARY EVALUATION

Size and Chemical Analyses

Representative portions were cut from each sample and size analyses determined. The size fractions along with the salt content of each are listed in Table 1. The results show the plus 2.4 and minus 0.6 mm size fractions for each sample to be below the 95% NaCl minimum road salt specifications. The minus 0.6 mm fractions, representing 9 to 9.5% of the total weight of sample(s), additionally do not meet the size specification for road salt. The intermediate fractions, minus 2.4, plus 1.2 mm, and

minus 1.2, plus 0.6 mm fractions, representing 28 to 32% of the total weight of samples, are within the 95% NaCl specification.

In view of the above, it was decided to essentially restrict test work to the plus 2.4 mm portion of the samples, this representing about 60% of the total weight of sample (63.1%, Sample 1; 58.0%, Sample 2).

Table 1. Size and chemical analyses of salt samples

Size (mm)	Sample 1		Sample 2	
	Wt. %	Salt Content Wt. %	Wt. %	Salt Content Wt. %
-6.7 +2.4	63.1	92.7	58.0	91.5
-2.4 +1.2	19.6	96.2	23.6	95.8
-1.2 +0.6	8.3	95.8	8.9	95.7
-0.6	9.0	86.5	9.5	87.5
Total	100.0	93.1*	100.0	92.5*

*Calculated

Mineralogical Examination

A full report of the mineralogy of these salt samples was prepared by Wilson and Petruk (2).

Examination by X-ray diffractometer, SEM, and image analyzer showed the major gangue material to be anhydrite, with quartz, calcite and dolomite as minor and trace minerals. Generally, the anhydrite occurs in the halite host as equigranular grains with sizes ranging from 100 to 200 μm. Further crushing to liberate the gangue minerals would of course render the salt too fine for use as road salt.

Beneficiation Tests

The process for upgrading the minus 6.7, plus 0.6 mm salt should be dry and preferably nonabrasive. Three techniques initially were considered, namely photometric sorting (colour sorting), electrostatic separation, and air tabling (gravity separation). Results with the latter two were not encouraging and these techniques were discontinued. The photometric sorting tests only are considered in this report.

The optical sorter used in this work, a Sortex 621M unit, is illustrated in Fig. 1. This unit consists mainly of (a) the feed system, (b) the optical box and amplifier, (c) the air ejector, and (d) the power supply. This unit separates mineral particles of different light reflecting properties (different shades or colours). While falling through the optical selector box, each mineral particle receives a complete surface inspection. Any particle that differs in colour or colour shade from that of a set background (standard), activates an electronic signal which in turn triggers a mechanism that emits a short blast of compressed air. The air blast deflects the particles from the main stream of particles into the reject stream.

Two series of tests were made, the first with minus 6.7 plus 2.4 mm, and the second with minus 2.4 plus 1.2 mm size fractions, the latter to determine whether the quality could be further upgraded beyond the noted 96.2% and 95.8% NaCl (Samples 1 and 2 respectively). The compressed air pressure had to be reduced from the normal 552 KPa (80 psi) to 138 KPa (20 psi) to prevent reject particles from being blown completely out of the reject stream.

Photometric sorting results are presented in Tables 2 and 3.

Table 2. Photometric sorting/product distribution, Sample 1

Screening			Photometric sorting				Road salt product*		
Size (mm)	Wt. %	% NaCl	Concentrate		Reject		Wt. % of total sample	% NaCl	Salt Recovery %
			Wt. %	% NaCl	Wt. %	% NaCl			
-6.7 +2.4	63.1	92.7	81.0	96.0	19.0	87.5	51.1	96.0	83.8
-2.4 +1.2	19.6	96.2	99.5	95.8	0.5	75.8	19.6	96.2	100.0
-1.2 +0.6	8.3	95.8	-	-	-	-	8.3	95.8	100.0
-0.6	9.0	86.5	-	-	-	-	-	-	-
Total	100.0	93.1**	-				79.0	96.0**	81.5

* Material with salt content greater than 95% is acceptable as road salt
**Calculated

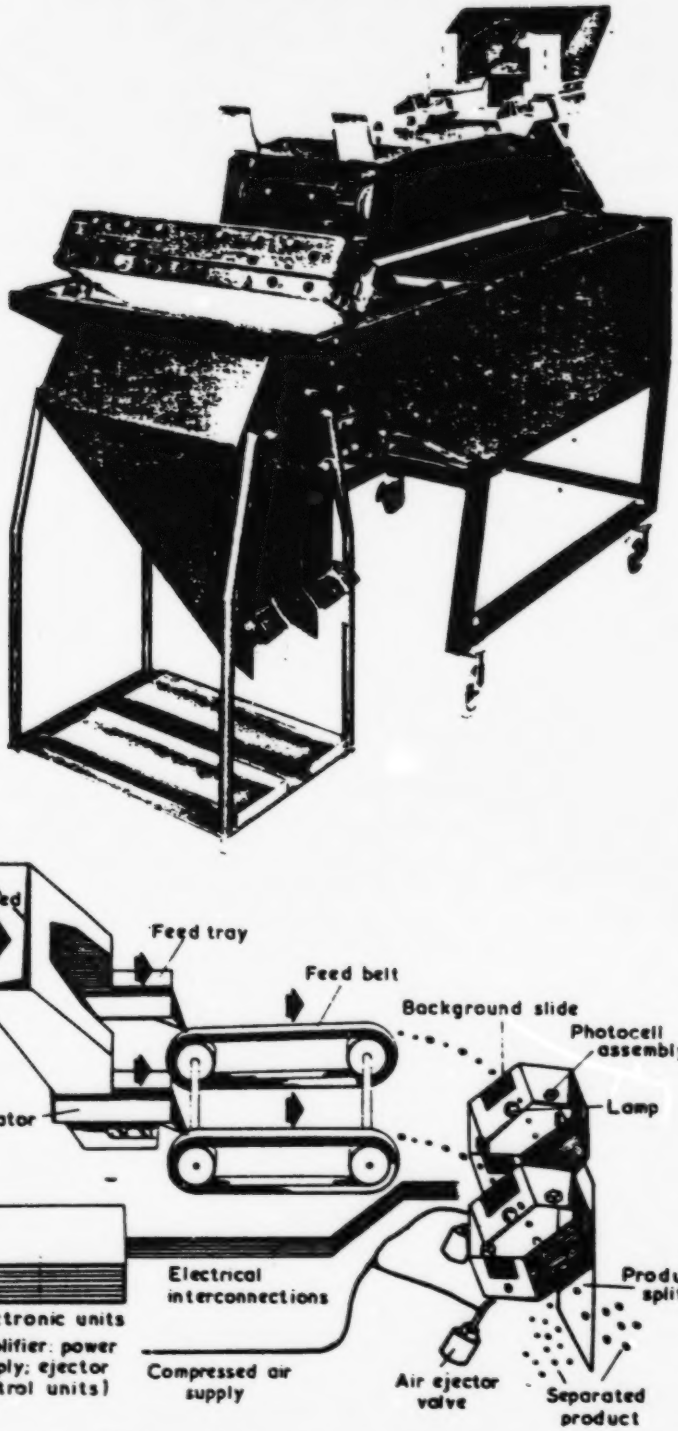

Fig. 1. The Sortex 621M unit and its schematic operation

Table 3. Photometric sorting/product distribution, Sample 2.

Screening			Photometric sorting				Road salt product*		
Size (mm)	Wt. %	% NaCl	Concentrate		Reject		Wt. % of total sample	% NaCl	Salt Recovery %
			Wt. %	% NaCl	Wt. %	% NaCl			
-6.7 +2.4	58.0	91.5	86.7	95.8	13.3	71.5	50.3	95.8	90.8
-2.4 +1.2	23.6	95.8	98.6	95.8	1.4	73.4	23.6	95.8	100.0
-1.2 +0.6	8.9	95.7	-	-	-	-	8.9	95.7	100.0
-0.6	9.5	87.5	-	-	-	-	-	-	-
Total	100.0	92.5**	-				82.8	95.8**	85.7

* Material with NaCl content greater than 95% is acceptable as road salt
**Calculated

Photometric sorting upgraded the minus 6.7, plus 2.4 mm size fractions for both salt samples to meet road salt specifications but it did not improve the salt content of the minus 2.4 + 1.2 mm fractions. These, however, already contained more than the required 95% NaCl prior to photometric sorting.

CONCLUSIONS

These results show that removal and discarding of the minus 0.6 mm fraction, coupled with photometric sorting of the minus 6.7 plus 2.4 mm fraction and combination of the 'accept' fraction with the minus 2.4, plus 0.6 mm, non-treated fraction, resulted in a recovery of 79 wt. % of the sample and 81.5% of contained salt in Sample 1 at a product grade of 96% NaCl and, for Sample 2, a recovery of 82.8 wt. % and of 85.7% contained salt at a grade of 95.8% NaCl. These products meet specifications for road salt with respect to both size and chemical purity.

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